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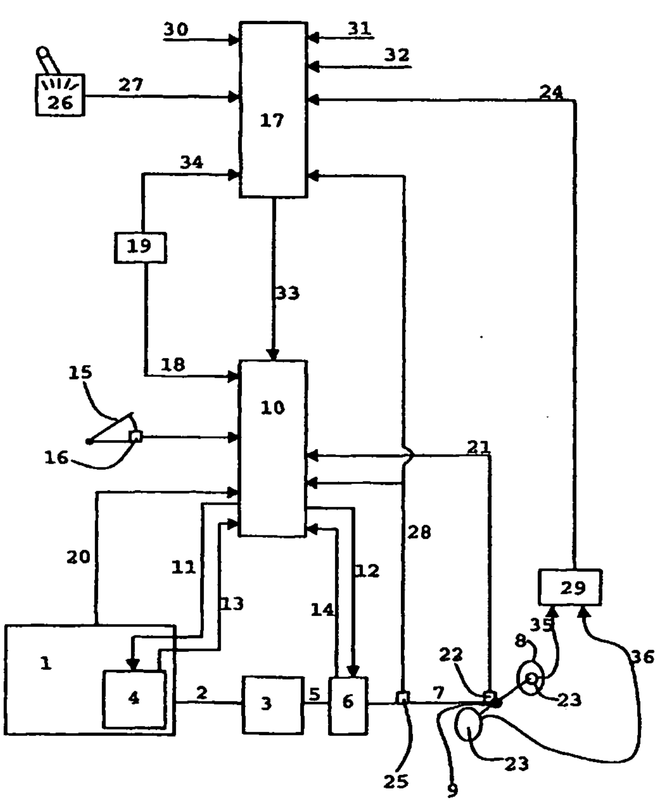
(54) Title: METHOD AND DEVICE FOR CONTROLLING OR REGULATING AUXILIARY BRAKE TORQUE IN A MOTOR VEHICLE



(57) Abstract: A method for controlling or regulating total auxiliary brake torque in a motor vehicle equipped with engine (1) and drive wheels (8), transmission components (2, 3, 5, 7, 9) incorporated between the engine and the drive wheels, at least one first auxiliary brake (4) of a first type and at least one first auxiliary brake (4) of a first type and at least one second auxiliary brake (4, 6) of a second type, different from the first type, the second auxiliary brake (4, 6) being constituted by a retarder (4, 6), characterized in that, if a request is made for the brake force from the auxiliary brakes to be moderated, then this is done by turning down or moderating, in the first place, the brake torque (4, 6) of the retarder.

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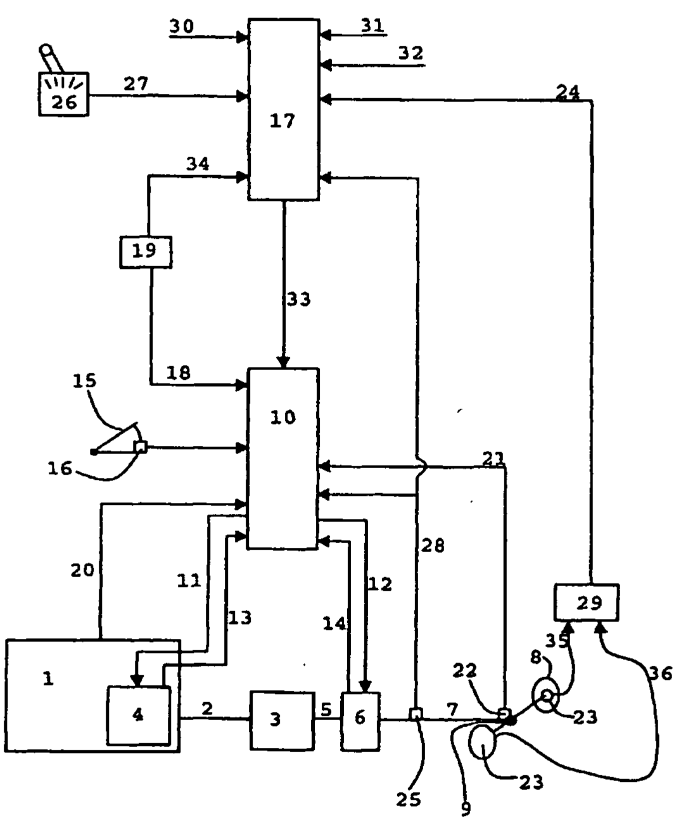

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 4420116 A1 (ZF FRIEDRICHSHAFEN AG), 14 December 1995 (14.12.95), column 7, line 67 - column 8, line 14, figure 1, abstract --	1-3,6
A	EP 0873924 A1 (VOITH TURBO GMBH & CO KG), 28 October 1998 (28.10.98), figure 1, abstract --	1-3,6
A	US 5762582 A (FRIEDRICH ET AL), 9 June 1998 (09.06.98), column 2, line 27 - line 34, abstract --	1-16

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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A	US 6062658 A (STUMPE ET AL), 16 May 2000 (16.05.00), column 6, line 43 - line 53, abstract	4,5,7-16

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Information on patent family members

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Patent document cited in search report			Publication date	Patent family member(s)			Publication date
DE	4420116	A1	14/12/95	WO	9533631	A	14/12/95
EP	0873924	A1	28/10/98	DE	19716923	A	29/10/98
US	5762582	A	09/06/98	AT	226160	T	15/11/02
				DE	4446288	A	29/06/95
				DE	59510427	D	00/00/00
				EP	0718166	A,B	26/06/96
				JP	8230625	A	10/09/96
US	6062658	A	16/05/00	DE	19604391	A	14/08/97
				FR	2745251	A	29/08/97
				JP	9207762	A	12/08/97

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US 5762582 A	09/06/98	AT 226160 T	15/11/02
		DE 4446288 A	29/06/95
		DE 59510427 D	00/00/00
		EP 0718166 A,B	26/06/96
		JP 8230625 A	10/09/96
US 6062658 A	16/05/00	DE 19604391 A	14/08/97
		FR 2745251 A	29/08/97
		JP 9207762 A	12/08/97

situations, such as, for example, when the vehicle is cold and lubricating oils in engine and transmission are viscous and brake differently than at normal running temperature or when various more or less worn parts in the drive line have an impact. Furthermore, there is no feedback, i.e. regulation in which estimated values are verified. In US 5921883, moreover, only a single auxiliary brake of the compression brake type is controlled. Nor does this system take any account of whether the brake force from the auxiliary brake is too high for the friction between the roadway and the drive wheels, i.e. that the vehicle starts to skid.

An auxiliary brake of the hydrodynamic retarder type usually comprises an impeller (rotor) and a turbine wheel (stator). The rotor is fixedly coupled to, for example, the cardan shaft of the vehicle and rotates with this. The stator is fixedly disposed in a retarder housing in which both the rotor and the stator are enclosed. The retarder housing is connected to an oil reservoir. When oil is squeezed into the retarder housing, it is set in motion by the rotor, which squeezes the oil against the stator. Since the stator cannot rotate, the flow of oil is retarded, whereby the rotor and the whole of the vehicle are braked. The brake torque is regulated by the quantity of oil in the retarder housing. The heat which is generated when the oil slows the rotor is usually dissipated via a heat exchanger coupled to the engine cooling system. This means that the retarder requires more cooling capacity from the engine cooling system compared with, for example, the above-stated compression or exhaust brake, in which a large part of the braking energy disappears directly out through the exhaust pipe. The maximum braking capacity of a retarder can usually be utilized only for relatively short periods, owing to the inadequate capacity of the cooling system.

An auxiliary brake of the electromagnetic retarder type usually comprises a stator in the form of electromagnets and a rotor in the form of soft-iron plates. The rotor is coupled to, for example, the cardan shaft of the vehicle and the stator is fixedly mounted in the vehicle. When current is connected to the electromagnets, a brake torque is generated upon the rotor when it rotates. The braking energy is converted into heat owing to the eddy currents formed in the soft-iron plate. In case of lengthy braking, the rotor is heated up so much that the formation of eddy currents is inhibited, thereby leading to a reduction in braking capacity, in case of lengthy use and maximum utilization of the capacity of the retarder, and even possibly to the total loss, in principle, of the braking capacity. The electromagnetic retarder is usually cooled by ambient air.

Vehicles equipped with more than one auxiliary brake often have more brake force at their disposal and therefore run a greater risk of exceeding the torque capacity of some transmission component in case of auxiliary braking.

Vehicles equipped with at least two purely primary auxiliary brakes, in which one of these two is a hydrodynamic retarder and the other auxiliary brake, for example, is a compression brake, enter into situations in which full power from both the auxiliary brakes is unnecessary and, in case of lengthy auxiliary braking, the retarder utilizes an unnecessarily large amount of the capacity of the cooling system as a result of the braking energy of the retarder having to be dissipated using the vehicle cooling system. After a relatively short time, auxiliary braking has to be halted owing to overheating of the cooling system.

Vehicles equipped with at least two purely primary auxiliary brakes, in which one of these two is an electromagnetic retarder and the other auxiliary brake, for example, is a compression brake, enter into situations in which full power from both the auxiliary brakes is unnecessary and, in case of lengthy auxiliary braking, the retarder is heated up so much that there is a risk of a reduction or total loss in the braking capacity of the retarder. This can be a problem if the driver, in such a situation, requests maximum auxiliary brake force from both the auxiliary brakes. The brake force will not be sufficient, which leads to the service brakes of the vehicle having to be used instead.

There is therefore a need for a method and a device for reciprocally controlling or regulating the auxiliary brakes of a vehicle, in which the type of auxiliary brake and the torque capacity of the transmission components are taken into account. This is the main object of the invention described below.

SUMMARY OF THE INVENTION

The solution of the problem, according to the invention, with due regard to the method and the device according to the invention, is described in patent claims 1 and 10. The remaining patent claims describe preferred embodiments and refinements of the method according to the invention (claims 2 to 9) and the device (claims 11 to 16).

The method according to the invention is a method for controlling or regulating total auxiliary brake torque in a motor vehicle equipped with engine and drive wheels, transmission components incorporated between the engine

and the drive wheels, at least one first auxiliary brake of a first type and at least one second auxiliary brake of a second type, different from the first type, the second auxiliary brake being constituted by a retarder. The invention is characterized in that, if a request is made for the brake force from the auxiliary brakes to be moderated, then this is done by turning down or moderating, in the first place, the brake torque of the retarder.

The foremost advantage of the method according to the invention is that the turning down or moderation of auxiliary brakes of the retarder type makes it possible, in the case of a hydrodynamic retarder, for example, to economize on the cooling capacity of the engine cooling system, thereby ultimately extending the duration of an auxiliary braking with a certain total brake torque before the engine cooling system boils over, and, in the case of an electromagnetic retarder, to avoid unnecessary heating of the retarder.

According to an advantageous embodiment of the method according to the invention, the auxiliary brakes are constituted by at least one primary and at least one secondary auxiliary brake, in which both the primary and secondary auxiliary brakes contribute to auxiliary braking and in which the secondary auxiliary brake is constituted by a retarder, in which case turning down or moderation is effected by turning down or moderating the secondary auxiliary brake in the first place.

Apart from the above-stated advantage, another advantage of this is that, as a result of the secondary auxiliary brake being moderated first, certain types of transmissions, disposed between the engine and the secondary auxiliary brake, are guaranteed to be spared

from being wrongly subjected to load, which would occur if the primary auxiliary brake were to be moderated first.

According to a further advantageous embodiment of the method according to the invention, the limit value is determined of one or more transmission components having the lowest torque capacity in case of auxiliary braking.

The advantage of this is that the method according to the invention ensures that the torque capacity for the vehicle transmission is not exceeded and hence expensive repairs can be avoided.

In one more embodiment, the effect of the estimated auxiliary brake torque is compared with a measured value, i.e. a value of the auxiliary brake torque, which value is actual to the situation, is measured, preferably in respect of the weakest transmission component in terms of torque. The auxiliary brake torque is adjusted upward or downward, depending on the measured value. The advantage of this is that an auxiliary braking is obtained which is better suited to the situation. By virtue of the measurement, any specific characteristics of the individual vehicle and specific situations, for example, such as when the vehicle is cold and lubricating oils in engine and transmission are viscous and brake differently than at normal running temperature, or when various greater or lesser worn parts in the drive line of the vehicle impact on the rotational resistance, are taken into account.

The device according to the invention is a device for controlling or regulating total auxiliary brake torque in a motor vehicle having transmission components coupled to an engine and at least two drive wheels coupled to the

transmission components, the device comprising at least one first auxiliary brake of a first type and at least one second auxiliary brake of a second type, different from the first type, the second auxiliary brake being a retarder, a control system for controlling or regulating the auxiliary brakes, in which control system are stored information on the characteristics of the respective auxiliary brake and at least one predefined limit value for maximally permitted auxiliary brake torque, characterized in that the control system is designed such that, if the limit value is exceeded or if a request is made for the brake force from the auxiliary brakes to be moderated, then this is done by turning down or moderating, in the first place, the brake torque of the retarder.

Here too there are embodiments which take account of the torque capacity of that transmission component which is weakest in case of auxiliary braking and of feedback, i.e. regulation through measurement and comparison with actual auxiliary brake torques.

The advantages are the same as for the various embodiments according to the method according to the invention.

Further advantageous embodiments of the invention can be derived from the following contingent patent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in greater detail below with reference to the appended figures, which, for illustrative purposes, show further preferred embodiments of the invention and the prior art and in which:

figure 1 shows a diagrammatic representation of an embodiment of the invention with control system, drive line and auxiliary brakes,

figure 2 shows a flow chart according to one embodiment of the method for controlling the auxiliary brake torque, and

figure 3 shows a flow chart according to another embodiment of the method for regulating the auxiliary brake torque.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Figure 1 shows a diagrammatic representation of a system according to the invention for controlling or regulating the auxiliary brake torque. An engine 1 is connected by its output shaft 2 to a transmission 3, which is the main transmission of the vehicle and which usually offers the possibility of driving the vehicle both forward and in reverse with many different gear ratios between the engine 1 and drive wheels 8. The transmission 3 can be equipped with auxiliary transmissions (for example splitter transmission or range-change transmission) in order to obtain more gears. In the engine 1 there is disposed a primary auxiliary brake 4. It should be noted that the primary auxiliary brakes can also be disposed between the engine 1 and the transmission 3 or in the transmission on its input shaft. An auxiliary brake of, for example, the compression brake type is disposed in the engine 1, while a retarder is usually disposed on the input shaft of the transmission 3. To the output shaft 5 of the transmission 3 is coupled a secondary auxiliary brake 6. The secondary auxiliary brake is usually of the hydrodynamic or electromagnetic retarder type. To the output shaft of the secondary auxiliary brake is usually

coupled the cardan shaft 7 of the vehicle. The cardan shaft 7 relays the drive force from the engine 1 further out to the drive wheels 8 via a rear axle 9. A secondary auxiliary brake 6 is disposed behind the transmission 3 of the vehicle, i.e. between the transmission 3 and the drive wheels 8. Centrally before the auxiliary braking device according to the invention is a control system 10 and 17, which, in the illustrative embodiment shown, comprises a first control unit 17 and a second control unit 10. The control units 10, 17 preferably comprise control computer units with microprocessors and memory units. A control computer can be a part of the on-board computer of the vehicle; alternatively, it can form part of some other control arrangement or can be a free-standing unit in the vehicle. In order to control or regulate the auxiliary brakes 4 and 6, the control unit 10 gives signals to the respective primary and secondary auxiliary brake 4, 6 via cables 11 and 12 respectively. The control system receives information on the status of the auxiliary brakes via the cables 13 and 14 respectively.

In the memory unit of the second control unit 10 are stored the characteristics of the auxiliary brakes 4 and 6, i.e. the brake force which is normally produced by the respective auxiliary brake 4 and 6 at different rev speeds and at different temperatures upon the working medium of the respective auxiliary brake and the air temperature around the vehicle. The working medium is normally constituted, in a hydrodynamic retarder, for example, by oil. In the electromagnetic retarder, the working medium is constituted by soft iron in the rotor plates. The air temperature around the vehicle impacts on the prospects for effective cooling of the respective component. The second control unit 10 ensures that the respective auxiliary brake cannot be engaged before the

working temperature of the respective auxiliary brake has been reached. Information on the working temperature of the auxiliary brakes is also stored in the second control unit 10.

The second control unit 10 further receives a signal on the position of the gas pedal 15 through the sensor 16. The cable 18 relays signals to the second control unit 10 from the cruise control 19 of the vehicle concerning whether the cruise control orders drive force from the engine 1 and whether the cruise control 19 is engaged or not. The cruise control 19 is of known type, having the functions on/off, set/coast and resume/accelerate. The cable 34 relays signals to the first control unit 17 concerning the vehicle speed which the cruise control 19 is set to maintain. It is not necessary to the invention for the vehicle to be equipped with a cruise control.

The cable 20 relays a signal from the engine, concerning the rotation speed of the engine, to the second control unit 10. Signals concerning the rotation speed of the cardan shaft 7 are relayed via the cable 28 to the control units 10 and 17. The rotation speed of the cardan shaft 7 is measured by the sensor 25. The cable 21 relays a signal to the second control unit 10 from a torque transmitter 22. The torque transmitter 22 measures the torque to which the rear axle 9 is exposed in case of auxiliary braking.

On the drive wheels 8 and also other wheels (not shown) of the vehicle, ABS brakes (brakes with anti-blocking system) with ABS brake sensors 23 are fitted. From the ABS brake sensors, a signal concerning the rotation speed of the drive wheels is relayed via cables 35 and 36. The service brake control system 29 of the vehicle compares the rotation speed of the various wheels of the vehicle

and registers whether any of the wheels of the vehicle are skidding, i.e. whether the difference between the rotation speed of the various wheels is too large. If skidding is present, a signal is given via the cable 24 to the first control unit 17 that any current auxiliary braking must totally cease or, alternatively, that the auxiliary brake torque must be turned down or moderated to the point where the vehicle regains grip and stability.

Through the control member 26 and the cable 27, coupled to the first control unit 17, the driver of the vehicle has the possibility of manually selecting different levels of auxiliary brake torque, alternatively of being able to select a certain deceleration. A given brake torque gives varying deceleration, depending on road gradient, road resistance, etc., while the deceleration option gives a certain deceleration, in principle regardless of the conditions.

The cable 30 relays a signal from a gradient transmitter (not shown) to the first control unit 17 concerning the gradient of the roadway. The cable 31 relays a signal from a weight sensor (not shown) to the first control unit 17 concerning the overall weight of the vehicle. A known alternative or supplement to the road gradient transmitter and the weight sensor is to measure the road resistance of the vehicle. By road resistance is meant a value calculated on the basis of the measured parameters: engine torque, vehicle acceleration/deceleration and the current mass of the vehicle. Altogether, the road resistance value can be used as an indication of road gradient, roll resistance and any tail wind or head wind. The road resistance signal is relayed via the cable 32.

The speed of the vehicle is obtained by measuring the rotation speed of the cardan shaft 7, i.e. using the sensor 25. The gear ratio in the rear axle 9 is usually permanent and hence the vehicle speed is given by measurement of the rotation speed of the cardan shaft.

Based on the information relayed via the cables 27, 28, 30, 31, 32, 34, and depending on whether the cruise control is engaged and set to a certain vehicle speed or whether the choice of brake torque/deceleration level has been made via the control member 26, the first control unit 17 will calculate in a known manner a value of the total auxiliary brake torque required, depending on: the conditions outside the vehicle, the instantaneous speed of the vehicle and the auxiliary braking level selected by the driver via the control member 26 or selected vehicle speed via the cruise control 19. The total auxiliary brake torque is the requested auxiliary brake torque.

The cable 33 gives information from the first control unit 17 to the second control unit 10 concerning the requested total auxiliary brake torque.

All sensors, i.e. torque transmitters, rotation speed meters, etc. are of known type and will not be described in any further detail within this patent application.

In figure 2 is shown one version of the steps in the method according to the invention, by which the second control unit 10 controls the total auxiliary brake torque in a motor vehicle. The method begins with the step 40 and in step 41 it is determined whether the conditions for auxiliary braking are met or not. This means that the second control unit 10 checks whether the gas pedal 15 is in a fully released position or not. The auxiliary

braking is blocked for as long as the driver accelerates, i.e. is fully or partially depressing the gas pedal 15. The second control unit 10 checks in this situation also whether the cruise control 19 is signaling to the engine control system (not shown) to provide the motor with some quantity of fuel, i.e. that driving force is demanded by the cruise control 19. If the above conditions are met, i.e. no signal for more fuel to the engine is present, then the execution continues to step 42. If the conditions in 41 are not met, then the execution continues to step 49, i.e. back in starting or call position 40. In step 42, the second control unit 10 determines the total auxiliary brake torque which is requested by the first control unit 17 via the cable 33.

In step 43, a limit value is determined for maximally permitted brake torque from the auxiliary brakes, based on torque capacity for a transmission component which has the lowest capacity in case of auxiliary braking. In the illustrative embodiment shown in figure 1, this weakest transmission component is the rear axle 9. The limit value is predetermined by laboratory tests and is stored in the memory unit in the second control unit 10. Most commonly, some component between the transmission 3 and the drive wheels 8 determines the limit value, which, in the illustrative embodiment shown, is determined by the rear axle 9.

In step 44, the second control unit 10 determines the gear ratio between the engine 1 and the drive wheels 8, preferably by measuring the rotation speed of the engine 1 and the rotation speed of the cardan shaft 7. The gear ratio in the rear axle 9 is usually permanent and hence the gear ratio between the engine 1 and the drive wheels 8 is known. An alternative to ascertaining the gear ratio is to provide a sensor which detects a position of the

gear selector (not shown) disposed on the transmission 3. The gear ratio between the engine 1 and the drive wheels 8 is only required to be known if the vehicle is equipped with at least one primary auxiliary brake.

In step 45, the second control unit 10 estimates, i.e. calculates, the size of the brake torque which the respective auxiliary brake needs to produce to achieve the requested total auxiliary brake torque. The equation for this includes the instantaneous gear ratio and the total auxiliary brake torque requested by the first control unit 17. The equation can appear as follows:

$$M = (\sum T_{ed} + \sum T_{pb}) \times (\text{gear ratio}) + T_{sb})$$

where

T_{ed} = the engine torque, i.e., in principle, the basic friction of the engine, plus any other assemblies coupled to the engine, such as, for example, compressed-air compressor, etc.;

T_{pb} = brake torque from the primary auxiliary brake 4, which, as previously, can be built into the engine 1 or can be free-standing;

T_{sb} = brake torque from the secondary auxiliary brake 6;

Gear ratio = instantaneous gear ratio between the engine 1 and the drive wheels 8;

M = the total auxiliary brake torque requested by the first control unit 17.

The distribution of brake torque which the respective auxiliary brake needs to produce in order to achieve a certain total brake torque is predetermined and is stored in the memory unit of the second control unit 10. The distribution is affected by the status and characteristics of the respective auxiliary brake (see previous section on characteristics of the respective auxiliary brake).

In step 46, the requested total auxiliary brake torque is compared with the limit value. If the requested auxiliary brake torque exceeds the limit value, the execution proceeds to step 47, i.e. the second control unit 10 chooses a new total auxiliary brake torque, the torque level of which lies directly below the torque level of the limit value. According to the invention, the turning down of this new total auxiliary brake torque is effected by turning down the brake torque of the secondary auxiliary brake 6. The amount by which the secondary auxiliary brake has to be turned down is calculated by the auxiliary brake torque M being chosen somewhat lower than the limit value (M_{max}) and by T_{sb} being isolated out and calculated. Remaining included variables in the equation are given as above. After step 47, auxiliary braking takes place in step 48 according to the chosen brake torque in step 47. If the requested total auxiliary brake torque, on the other hand, does not exceed the limit value, then the execution continues to step 48, i.e. the auxiliary braking is effected according to the chosen brake torque.

The equivalent occurs in a vehicle equipped with just primary auxiliary brakes, in which one of at least two auxiliary brakes, but not the second one(s), is constituted by a retarder. In this kind of realization, the retarder is turned down in step 47.

The steps as above are executed in the second control unit 10 continuously according to predetermined time intervals, which are usually limited by the computing capacity of the microprocessors. Correspondingly, the first control unit 17 continuously calculates a requested total auxiliary brake torque on the basis of given assumptions. In this way, the total auxiliary brake

torque is continuously controlled throughout a current auxiliary braking.

In order to implement the method for controlling the auxiliary brake torque according to figure 2, the device in figure 1 does not need to be equipped with the torque transmitter 22.

In figure 3, a modified version of the method according to the invention according to figure 2 is shown. The method starts in this case with the step 40 and is identical with the embodiment according to figure 2, up to and including step 48. According to this version, the number of steps is increased with a view to utilizing the torque transmitter 22 and hence obtaining a total auxiliary brake torque which is better suited to the auxiliary braking situation, i.e. a regulation of the auxiliary brake torque.

In step 50, the actual auxiliary brake torque is measured by the torque transmitter 22. In step 51, the auxiliary brake torque is adjusted, according to the final stage 48, upward or downward depending on the measured value in step 50 and depending on the size of the measured value relative to the limit value. The auxiliary brake torque is adjusted so that it ends up precisely below the limit value. In step 52, the auxiliary braking continues with possibly adjusted brake torque.

During the continued auxiliary braking, i.e. execution number two and the following executions, account will be taken of the signal from the service brake control system 29 via the cable 24. If the service brake control system registers skidding, then a ramping down of the requested total auxiliary brake torque from the control unit 17 will be automatically initiated, until the service brake

control system 29 no longer registers skidding. The different levels of the ramping down are predetermined and stored in the memory unit in the control unit 17. The control unit 17 ramps down on the basis of the requested total auxiliary brake torques of the preceding execution. In this way, the requested total auxiliary brake torque is also regulated with due regard to the state of the road. In the next execution in the control unit 17, the next step in the ramping down is performed, if so required. The influence of the service brake control system 29 implies, in the final analysis, a gradual moderation of the brake torque of the secondary auxiliary brake. The moderation of the retarder 6, i.e. the secondary auxiliary brake, by ramping down continues for each new execution in the control unit 10 until the service brake control system 29 registers that the vehicle wheels have stopped skidding.

Viewed overall, the auxiliary brake torque is controlled and regulated in steps 48 and/or 51 by:
- the request of the driver,
- the request of the cruise control,
- the torque capacity of the transmission component,
- the nature of the road base,
- surrounding topology and road resistance, and
- the peculiarities of the individual vehicle, temperatures, etc. in the drive line.

If the situation were to arise in which the retarder 6 has been maximally turned down or moderated, i.e. it is fully closed off, and this is definitely not sufficient to get below the limit value, then the second control unit 10 will begin to turn down or moderate the braking effect also of the primary auxiliary brake. The equivalent applies if the vehicle is equipped with just primary auxiliary brakes.

In the device according to the invention, the brake torque in the various auxiliary brakes is built up parallel to the requested or estimated brake level. When the brake torque has to be turned down or moderated, this is effected by moderation, in the first place, of the retarder in the auxiliary brake system.

The invention is not limited to the embodiments described above. The respective primary and secondary auxiliary brakes can comprise, for example, two or more primary and secondary auxiliary brakes respectively. Alternatively, the auxiliary brakes can comprise only two or more primary auxiliary brakes.

The cables or the information channels in the embodiments described above are preferably of the electric cable or optic cable type. Wireless information transfer is also possible. The information channels can, in turn, form part of the data bus system of the vehicle. The device according to the invention is not, however, limited to said signal-relaying devices.

PATENT CLAIMS

1. A method for controlling or regulating total auxiliary brake torque in a motor vehicle equipped with engine (1) and drive wheels (8), transmission components (2, 3, 5, 7, 9) incorporated between the engine and the drive wheels, at least one first auxiliary brake (4) of a first type and at least one second auxiliary brake (4, 6) of a second type, different from the first type, the second auxiliary brake (4, 6) being constituted by a retarder (4, 6), characterized in that, if a request is made for the brake force from the auxiliary brakes to be moderated, then this is done by turning down or moderating, in the first place, the brake torque (4, 6) of the retarder.

2. The method as claimed in claim 1, characterized in that the first type is constituted by an engine brake (4) or ISG (Integrated Starter Generator).

3. The method as claimed in claim 1, characterized in that the second type is constituted by a hydrodynamic retarder (6), which utilizes the vehicle cooling system to cool the hydrodynamic retarder (6), or by an electromagnetic retarder (6), which can acquire worsened braking effect with increased working temperature.

4. The method as claimed in claim 1, characterized in that the method comprises the steps:

- determination of whether auxiliary braking is requested (41);
- determination of requested total auxiliary brake torque (42);
- determination of the limit value for maximally permitted auxiliary brake torque (43);

- estimation of brake torque from the respective auxiliary brake in order to achieve requested total auxiliary brake torque (45);
- evaluation of whether the requested total auxiliary brake torque exceeds the limit value (46);
- if the requested total auxiliary brake torque exceeds the limit value, the auxiliary brake torque is chosen at a level directly below the limit value by turning down (47) or moderation (47) of the retarder (4, 6);
- following turning down or moderation, auxiliary braking is effected, based on the requested auxiliary brake torque and the limit value (48);
- continuous controlling or regulation of the total auxiliary brake torque during current auxiliary braking, depending on the requested auxiliary brake torque and depending on new comparisons, repeated at intervals, with the limit value.

5. The method as claimed in any of the preceding claims, characterized in that if the turning down or moderation of the second auxiliary brake is not sufficient to get below the limit value, then the first auxiliary brake is also turned down or moderated.

6. The method as claimed in any of the preceding claims, characterized in that, where the first and second auxiliary brakes are constituted by at least one primary (4) and at least one secondary (6) auxiliary brake, in which both the primary and secondary auxiliary brakes contribute to auxiliary braking and in which the secondary auxiliary brake is constituted by a retarder (6), then turning down or moderation is effected by turning down or moderating the secondary auxiliary brake.

7. The method as claimed in any of the preceding claims, characterized in that the limit value is

determined of one (9) or more transmission components having the lowest torque capacity in case of auxiliary braking.

8. The method as claimed in claim 7, characterized in that the total auxiliary brake torque is regulated by measurement (50) of the torque upon that transmission component (9) having the lowest torque capacity in case of auxiliary braking and in that the measured torque is compared with the limit value and in that the auxiliary torque, if required, is adjusted so that it ends up precisely below the limit value (51).

9. The method as claimed in any of the preceding claims, characterized in that the total auxiliary brake torque is determined by utilization of information pertaining to the instantaneous vehicle weight (30) of the vehicle and/or the instantaneous road gradient (31) of the vehicle and/or the instantaneous road resistance (32) of the vehicle.

10. A device for controlling or regulating total auxiliary brake torque in a motor vehicle having transmission components (2, 3, 5, 7, 9) coupled to an engine (1) and at least two drive wheels (8) coupled to the transmission components (2, 3, 5, 7, 9), the device comprising at least one first auxiliary brake (4) of a first type and at least one second auxiliary brake (4, 6) of a second type, different from the first type, the second auxiliary brake (4, 6) being a retarder (4, 6), a control system (10, 17) for controlling or regulating the auxiliary brakes, in which control system are stored information on the characteristics of the respective auxiliary brake (4, 6) and at least one predefined limit value for maximally permitted auxiliary brake torque, characterized in that the control system (10, 17) is

designed such that, if the limit value is exceeded or if a request is made for the brake force from the auxiliary brakes (4, 6) to be moderated, then this is done by turning down or moderating, in the first place, the brake torque of the retarder (6).

11. The device as claimed in claim 10, characterized in that the first type is constituted by an engine brake (4) or ISG (Integrated Starter Generator).

12. The device as claimed in claim 10, characterized in that the second type is constituted by a hydrodynamic retarder (6), which utilizes the vehicle cooling system to cool the hydrodynamic retarder (6), or by an electromagnetic retarder (6), which can acquire worsened braking effect with increased working temperature.

13. The device as claimed in claim 10, characterized in that at least one primary auxiliary brake (4) and at least one secondary auxiliary brake (6) constitute the auxiliary brakes (4, 6) and in that a retarder (6) constitutes the secondary auxiliary brake and in that the control system (10, 17) is set up to turn down or moderate the secondary auxiliary brake if the limit value is exceeded.

14. The device as claimed in either of claims 10 and 11, characterized in that at least one of said transmission components is a transmission component (9) with lowest torque capacity, which component determines the limit value.

15. The device as claimed in any of claims 10 to 12, characterized in that a torque-measuring device (22) is coupled to the control system (10), which measuring

device is fitted to any one (9) of the transmission components with lowest torque capacity.

16. The device as claimed in any of claims 10 to 13, characterized in that coupled to the control system (17) are information channels through which the control system (17) receives information on vehicle speed (25) and/or gear ratio (20, 25) between engine and drive wheels and/or vehicle weight (30) and/or road gradient (31) and/or road resistance (32).

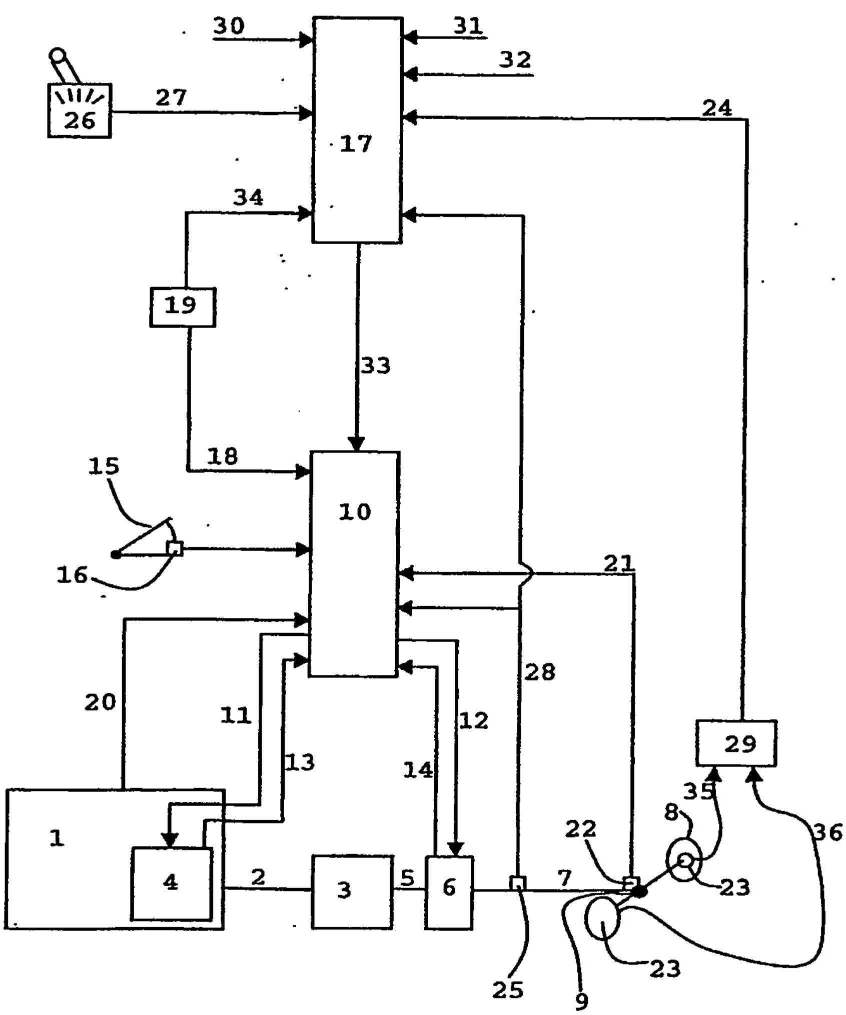
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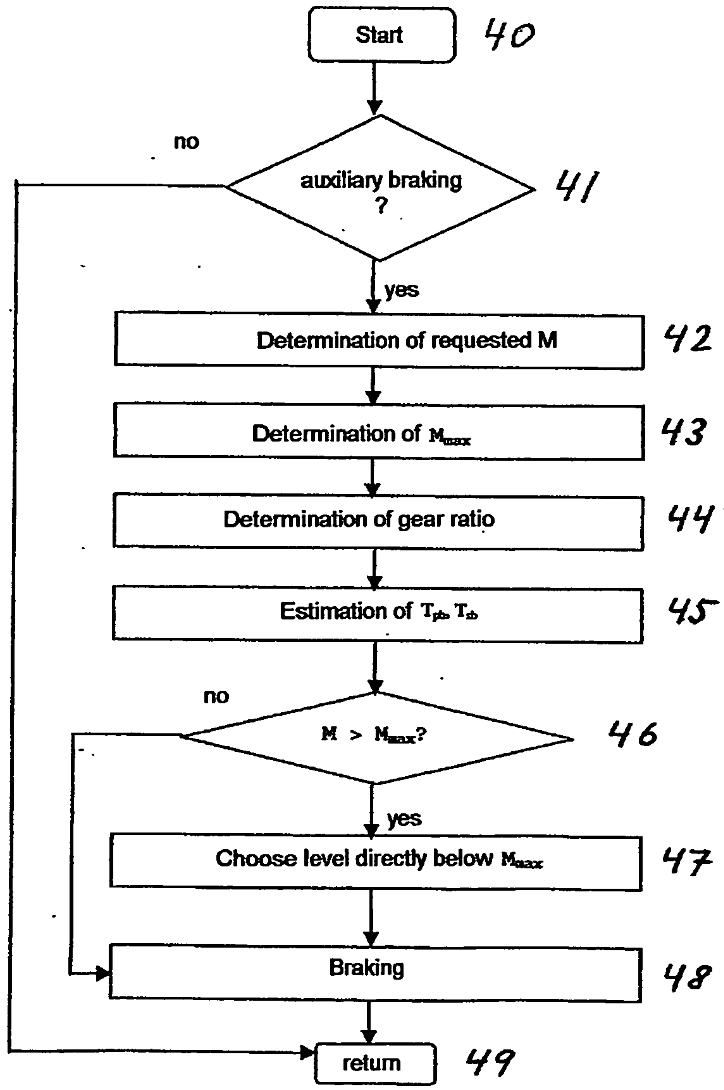
Fig. 1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40
auxiliary braking ?
no
yes
41
Determination of requested M
42
Determination of M_{max}
43
Determination of gear ratio
44
Estimation of T_{pb}, T_{sb}
45
M > M_{max}?
no
yes
46
Choose level directly below M_{max}
47
Braking
48
return
49

Fig. 2

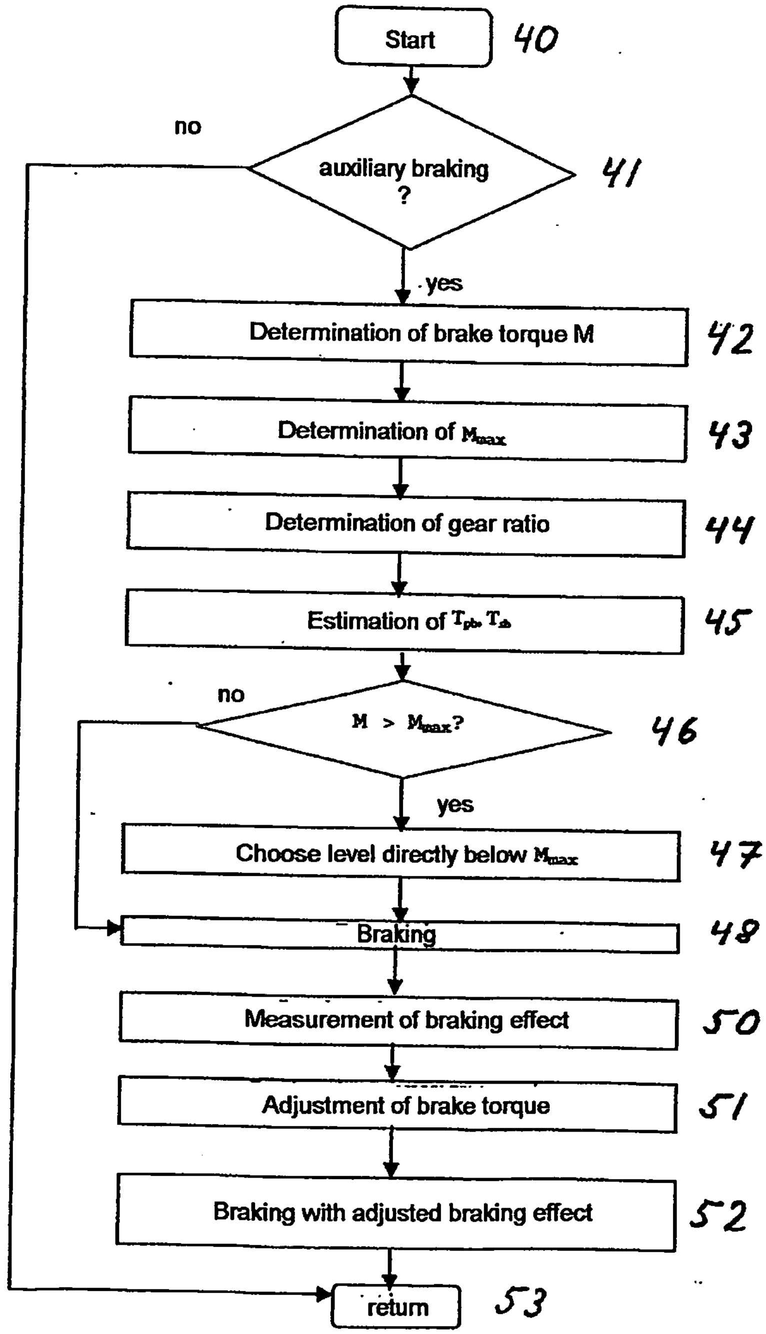
Start
40
no
auxiliary braking ?
41
yes
Determination of brake torque M
42
Determination of M_{max}
43
Determination of gear ratio
44
Estimation of T_{pb}, T_{sb}
45
no
$M > M_{max}$?
46
yes
Choose level directly below M_{max}
47
Braking
48
Measurement of braking effect
50
Adjustment of brake torque
51
Braking with adjusted braking effect
52
return
53

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/02460

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B60T 8/00, B60T 10/00, B60T 10/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 4420116 A1 (ZF FRIEDRICHSHAFEN AG), 14 December 1995 (14.12.95), column 7, line 67 - column 8, line 14, figure 1, abstract --	1-3,6
A	EP 0873924 A1 (VOITH TURBO GMBH & CO KG), 28 October 1998 (28.10.98), figure 1, abstract --	1-3,6
A	US 5762582 A (FRIEDRICH ET AL), 9 June 1998 (09.06.98), column 2, line 27 - line 34, abstract --	1-16

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 April 2003	22-04-2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Alexandra Jarlmark/EK Telephone No. +46 8 782 25 00

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6062658 A (STUMPE ET AL), 16 May 2000 (16.05.00), column 6, line 43 - line 53, abstract	4,5,7-16

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INTERNATIONAL SEARCH REPORT

Information on patent family members

29/03/03

International application No.
PCT/SE 02/02460

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
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EP	0873924	A1	28/10/98	DE	19716923	A	29/10/98
US	5762582	A	09/06/98	AT	226160	T	15/11/02
				DE	4446288	A	29/06/95
				DE	59510427	D	00/00/00
				EP	0718166	A,B	26/06/96
				JP	8230625	A	10/09/96
US	6062658	A	16/05/00	DE	19604391	A	14/08/97
				FR	2745251	A	29/08/97
				JP	9207762	A	12/08/97